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JUTE RESEARCH AND DEVELOPMENT

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INDIA

Technical report: Third mission report*

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of R.R. Atkinson
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United Nations Industrial Development Organization
Vienna

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This report gives an account of the progress which has been made in the project since the Second Mission of the CTA in November 1987.

Summary

1. Laboratory equipment.

Of the 12 items on order, 8 have been received and a further 2 have been shipped. One of the items has been received without an essential part - this has been taken up with PAC.

2. Fellowships.

Five Fellowships have been cleared and are now being processed by Training Branch.

3. Pilot plants.

Bids have been received for intersecting gill boxes, yarn and fabric bleaching and dyeing equipment and automatic sack-sewing equipment and are under examination by the project staff for final selection. Arrangements are going ahead for the pilot plant sites but no physical work has started yet.

4. Accommodation.

The offices are now in operation. The construction of laboratory space over the offices has not started due to a delay in getting planning permission. The assistance of the Jute Commissioner and the Resident Representative, UNDP, Delhi has been sought to try to overcome this difficulty. This delay in the provision of laboratory space will be reflected in the late use of equipment as planned.

5. Staff.

Most of the 30 staff are in place and further recruitment for the remainder is in progress.

6. Sub-contracts.

The terms of reference for jute-reinforced plastics research and development have been drafted and will be discussed with the sub-contractor in June. A decision about the other two sub-contracts has been postponed until November 1988 when the first Tri-partite Review will be held.

7. Study tours.

Two out of the five which are planned remain to be undertaken. It is expected that these will be made in 1989.

B. Experts.

Five experts have been identified and their job descriptions prepared for recruitment.

9. Tri-partite Review.

The first tri-partite review will be held in November 1988 after the first internal project evaluation.

10. Project Advisory Committee.

One meeting of the PAC was held on 4 April. Minutes will be prepared by the project staff.

11. Project revision.

It is proposed that a revision of parts of the project be made at the time of the first TPR. This will take the form of dropping the sub-contract on fabric engineering and replacing it with another on product engineering. An additional objective with its inputs, activities and outputs will be considered on the subject of wrap-spun yarns also.

Conclusions

Although considerable progress is being made in the project there is a danger of slippage if certain items are not dealt with during the next few months. The laboratory space and the pilot plant sites should be ready as quickly as possible otherwise the installation of equipment may be delayed. In certain areas the exact programme of work to be followed has not been defined with sufficient clarity yet and this should be given attention so that when the equipment arrives it may be used to pursue the programme of development in a planned manner.

Through IJIRA's own research programme virtually all of the work planned under the heading of "fabric engineering" has been completed already so it is proposed to replace this with a new objective/input/activity/output based upon ultrasonic bonding processes which the National Project Director and the Head of the Mechanical Processing Division saw during their study tours. A new objective is proposed covering the use of wrap-spun yarns in primary carpet backing. Much of this work is in progress in IJIRA and the UNIDO inputs will be limited to fellowships, a study tour and the provision of an Expert.

The remainder of this report gives in detail the progress being made in the various sectors of the project.

Laboratory equipment

Only four of the 12 items which were cleared for purchase in November 1987 remain to be received. One tri-carb analyser was received without a dot-matrix printer without which it cannot be used. This matter has been notified to PAC in Vienna. Some minor items still required will be ordered later.

Wherever possible this equipment will be used in IJIRA's own labs until the project labs are ready.

Pilot plants

Prices and specifications have been received for the plant required for fibre blending, yarn and fabric bleaching and dyeing and these are in course of examination by the Divisional Heads at IJIRA.

Enzyme fermentation plant:

This has been the subject of much thought and discussion but now some progress has been made since the last mission in November 1987. The position now is this: the enzyme plant at the Central Food Technology Research Institute (CFTRI) at Mysore has been visited by IJIRA scientists and trials conducted to produce 100 kg of the active enzyme wanted for softening low-grade jute fibre. Laboratory examination showed that this enzyme was of a higher grade than that produced by IJIRA's own plant. It seems that the production time can be reduced to 48 hours so two 100 kg plants would give enough material to treat 30000 kg of low-grade jute daily i.e. about 90000 kg of the total raw materials. The plant can produce solid or liquid extract, the latter being preferred by the mills. Although it is certain that the enzymes from this plant are quite satisfactory, confirmatory mill trials are to be carried out.

Since CFTRI is not a commercial company it does not fabricate fermentors. It will however provide all the drawings, technical specifications and suppliers of the component parts

as well as attend commissioning trials. Their fee for this service is \$ 4000 and the National Project Director will authorise this expenditure. It is likely that the one machine will cost about \$ 80,000 and two machines will cost about \$95,000 (because of common components) . When the time comes to purchase the components, neutral specifications will be required for competitive tendering and it is recommended that Indian manufacturers be placed on the tenderers list.

However since this is a major purchase it is suggested that PAC, Vienna should at the same time source a suitable type of fermentor from one supplier. The Head of the Biology Division should therefore submit a purchase requisition along with a neutral specification to PAC. One reason for this lies in the guarantee position. If the CFTRI plant is assembled, (presumably by some acceptable Indian engineering company) there cannot be a blanket guarantee that the whole will operate properly, even if the individual components are guaranteed . At the Project Advisory Committee meeting, this point was raised and the National Project Director was requested to approach CFTRI formally to ask them to give a guarantee that the whole plant would operate correctly. At the same meeting the Jute Commissioner thought that since both IJIRA and CFTRI were under government funding and control it should be possible to work some form of guarantee. If PAC can locate a suitable fermentor even at a slightly higher price it might be more prudent to purchase this one and get a normal guarantee with it.

It is planned to locate this plant at Birla Jute Mills but the original site selected has proved to be unsuitable. A new site has been put forward but this requires the construction of a 200 m² (?) shed with attendant services. This is a Government of India expense and early clearance should be sought.

Automated sack sewing line

After quite some time the manufactures who were approached for this plant, Union Special/Carl Schmale (US/CS) submitted quotations for an automatic cutting and hemming machine and an automatic side seam sewing system. Both these machines would form the bag completely automatically but with manual feed, transfer and receipt of the finished bags. The prices for the machines were prohibitive - \$ 220,000 for the former and \$ 150,000 for the latter. Additionally, a further \$ 400,000 were being asked for development costs. Even if the development costs were completely waived the cost of this equipment related to its output and possible labour savings puts it completely out of court. (see Appendix 1.)

It is essential that work be begun on the preparation of each mill site as soon as machinery dimensions and service requirements are available.

The selected sites are:

Chemical softening of jute

Reliance Jute and Industries Ltd, Calcutta
J K Jute Mills Ltd, Kanpur

i/c Dr A K Mukherjee, Applied Chemistry Div.

Blending

Birla Jute and Industries Ltd, Calcutta

i/c Mr S Palit, Mechanical Processing Div.

Dyeing and bleaching (yarn)

Birla Jute and Industries Ltd, Calcutta

i/c Dr A K Mukherjee, Applied Chemistry Div.

Dyeing and bleaching (cloth)

Anglo-India Jute Mills Ltd, Calcutta

i/c Dr A K Mukherjee, Applied Chemistry Div.

Bio-softening of jute

Birla Jute and Industries Ltd, Calcutta

i/c Dr B L Ghosh, Biology Div.

In addition to the machinery spaces each mill will provide office accommodation for 2-3 staff. The mills have yet to sign the formal agreements with IJIRA covering the use of the pilot plants but they have all agreed to co-operate in the project.

Fellowships

The following Fellows are in course of placement:

Jute-reinforced plastics (Pal)	Harwell Laboratories	UK
Bio-softening (Sinha)	Oak Ridge Laboratories	USA
Bio-softening (Chakrobarty)	University of Colorado	USA
Chemical softening (Battacharjee)	Personal Products	USA
Bleaching and dyeing (Guahoy)	UMIST	UK

These account for 21 man-months out of the 57 given in the Project document. The remainder should be specified this year for implementation in 1989.

Accommodation

The project office is complete and functioning. The laboratory space above the office block has not been constructed yet because of a delay in getting planning permission from the Calcutta Municipal Authorities. All the plans, allocation of materials and selection of builder have been prepared but this formality is holding up progress. It is hoped that through the offices of the Jute Commissioner and the UNDP office in Delhi some pressure can be brought to bear and that the necessary permission to build can be obtained soon. It is unfortunate that when the laboratory equipment is arriving it cannot go immediately to its proper position. While some will be used in the IJIRA laboratories, it is clearly regrettable that this has to be done.

The Divisional Heads who are going to have pilot plant at the various mills require to be quite specific about the sites which each mill is going to provide. They should prepare site drawings and decide at the earliest opportunity where their machinery will be placed and which services they require. Naturally, they should do this in conjunction with the local mill management but it should be borne in mind that this is project machinery for which they are responsible and the ultimate decisions will be made, through them, by the National Project Director.

Staff

Most of the thirty project staff have been recruited and during the CTA's visit offers were made to an industrial engineer and a marketing officer. The staff has been recruited in equal parts from IJIRA and from outside. Those staff members who are to be working at the pilot plants have been stationed there and only visit the project office once a week for reporting and administration purposes.

Those staff members who have been brought in from outside are all on contractual employment for the duration of the project and the ex-IJIRA staff will revert to IJIRA at the end of the project. The staff are being paid some 5% above the normal IJIRA rates to attract the best candidates and to act as an incentive. It must be recorded that this arrangement, coupled with the physical separation of the project premises, has given rise to a degree of animosity between the IJIRA staff and the project staff. This will need careful attention by the National Project Director and the Divisional Heads to ensure it does not retard the progress of the project.

Sub-contracts

It was previously planned to execute a joint sub-contract at Clemson University covering the subjects of fibre blending and fabric engineering. Difficulty has been experienced in deciding on the precise terms of reference for these subjects but as a result of lengthy discussions during this mission the position now is this:

Blends.

The staff who are involved in this subject require to be quite sure of which aspect of this subject they wish to cover. Three areas were put forward, namely blends of jute and other fibres for (a) carpet pile yarns (b) soft luggage and (c) upholstery. The first is at present under investigation by the International Jute Organisation and it would seem therefore prudent to await the outcome of this work. The second seemed to have a limited scope but the third - upholstery - in the Indian context seemed to offer most promise. However, which ever

of these topics is finally chosen (and there should be no more than one) some member of the project should collect as much data as he can on the particular end-use such as

- the type of yarns (count, twist, fibres etc)
- the properties of the yarns and fabrics
- who makes these products and at what price
- what are the distribution channels
- would a jute blend be compatible
- etc etc

In other words, he should learn as much as possible about the products in which it is hoped that jute can be used as a blend material. Once a market has been identified then clearer terms of reference may be written.

Fabric engineering.

The project document shows that this topic will concentrate upon re-designing certain common fabrics in such a manner that they are made lighter in weight while retaining sufficient strength and durability for their particular end-use. This would make them cheaper and so improve their competitiveness in the market. An examination of IJIRA's annual reports on its research activities over the past three years shows, in fact, that much of this work has already been done. IJIRA has reached the stage of supplying large numbers of experimental sacks and bags to the Indian cement industry and the Indian food authorities for trial. The sub-contract is therefore unnecessary and indeed IJIRA is better placed to continue this work than anyone else. Therefore it is proposed to modify the project document at the first TPR in November by dropping this topic and replacing it with another entitled "product engineering".

During the study tours of the National Project Director and the Head of the Mechanical Processing Division discussions were held at Clemson University with Dr Boswami of the Textile Faculty on the need for the industry to find new processes and markets through which it could enter new markets. Boswami demonstrated the work on ultra-sonic bonding of textiles in which his

departament was a leader. In effect, a mixture of a thermoplastic fibres with some other is subjected to ultra-sonics with the effect that the thermoplastic fibres melt and coagulate with the other fibres to form a non-woven web. The mass of fibre is, as it were, "spot welded" by ultra-sonics. It appeared that here was a way of making bonded webs of jute mixed with polypropylene fibres. Samples of such a mixture were subsequently sent to Clemson and some trials were carried out which apparently showed some promise. The proposal therefore is to give Clemson a sub-contract to develop some way of using this process for jute and jute mixtures. However before any work is begun, some idea of the end-use for such products is required. The National Project Director sees these as non-woven pipe insulation bindings (made from a sliver), non-woven webs for substrates (made from full width card slivers) and, perhaps the most interesting, laminated jute fabric (where polyethylene film is bonded cheaply and easily to jute fabric for forming sacks to hold hygroscopic materials. This is not a new product but the manner of bonding would be new and cheaper than existing methods.) In order to investigate this further it was agreed by the National Project Director and the back-stopping officer of UNIDO that the CTA should make a short visit to Clemson for discussions about this proposed activity. (He would also discuss the blend programme. It is requested therefore that the project staff should clarify their ideas about blends before his visit).

Jute-reinforced plastic sub-contract

Terms of reference will be finalised when the back-stopping officer and the CTA visit the contractor in July 1988.

Experts

The "duties" required for the Job Descriptions for Experts have been edited and now are given below with, where possible, names of possible contacts.

Post 11-02 Bio-softening of jute

Dr S K Niyogi, Oak Ridge National Laboratory, PO Box Y, Oak Ridge, Tennessee 37831, USA

- review the research work already carried out by IJIRA in the use of enzymes for (a) upgrading and softening low-grade jute fibre and (b) modifying tamarind kernel powder which is used in jute sizing.
- assist IJIRA towards the successful establishment of pilot-scale production of enzymes in wheat-bran culture of the selected fungus by means of solid state fermentation.
- guide IJIRA microbiologists in protein/genetic engineering techniques for upgrading the fungal strain by mutation so as to augment the production of specific enzymes found to be relevant to fibre softening and modification of sizing pastes.
- present a report on enzymatic softening and tamarind kernel powder modification in a form suited to dissemination to the industry. Another more detailed scientific report will be presented to IJIRA giving a comprehensive account of the work carried out.
- suggest a programme of work by which IJIRA may improve its strains of enzymes and widen the commercial acceptability of the process.

Post 11-03 Chemical softening of fibres

Dr P K Chatterjee, Personal Products Inc, Johnson & Johnson, Milltown, New Jersey, USA

- make a study of the work already carried out by IJIRA on the softening and upgrading of low quality jute by the use of appropriate chemicals and suggest ways in which it could be improved

- assist the IJIRA staff to implement pilot-scale use of such chemicals
- guide the IJIRA staff in ways of widening the scope for chemical softening in the industry
- prepare a report in a form suited to the needs of the industry to encourage the use of chemical softening showing the technical and economic advantages to be gained by such practices. A fuller, more scientific report giving an account of the work carried out will be presented to IJIRA and giving suggestions for future work programmes.

Post 11-04 Instrument engineer

Salford Business Centre, Salford University, Salford, England

- make a review of all the instruments which IJIRA has developed and make suggestions for improving their design, quality and reliability
- assist IJIRA staff to upgrade and modernise these instruments with the incorporation of micro-processors.
- examine the facilities which IJIRA has (or can call upon) for making mill instruments and suggest ways of improving them
- guide and assist the project staff to establish a small instrumentation workshop where instruments may be made in relatively small numbers for the industry
- present to IJIRA a full report on the work which has been carried out

Post 11-10 Industrial Engineer

Mr D Blyth, Scottish College of Textiles, Galashiels, UK

- visit representative mills assessed by IJIRA as good, medium and poor to obtain a overall picture of production and managerial methods and to gain an insight into the socio-political industrial environment
- conduct at least three seminars/workshops/discussions for company directors and senior managers on industrial engineering. The

experience gained during the mill visits would be incorporated into these meetings

- suggest improvements in IJIRA's existing methods of productivity measurement and suggest ways in which it could be widened
- suggest future lines of work for IJIRA's productivity cell and mill technical service
- prepare a full report of the work carried out

Post 11-13 Textile chemist (dyeing, bleaching and finishing)

Prof Miles, Dept of Textiles, UMIST. Manchester, England

- make a critical review of bleaching and dyeing methods for jute
- assist IJIRA staff to improve and develop suitable processes for bleaching, dyeing and finishing jute yarns and fabrics
- assist IJIRA staff in the use of pressure dyeing equipment for yarn and open-width dyeing of fabric and in the development of processing routes which will help to expand jute's markets
- participate in at least three seminars/workshops/discussions for senior management to promote the wider use of colouration methods which will allow jute and jute blends to enter new markets
- write a full account of the work which has been carried out and make recommendations for future development work

The remainder of the Experts' job descriptions require to be worked on and it is hoped that they can be finalised during the next mission of the CTA.

Project revision and tri-partite review

It has already been explained why it is proposed to drop one section of the project, Fabric Engineering, and replace it with Product Engineering.

The National Project Director has proposed a new activity for development of wrap-spinning with reference to tufted carpet primary backing and jute blended wrap-spun yarn for carpet pile. UNIDO'S inputs are limited to Fellowships, a study tour and the provision of a tufting Expert. The draft for this activity follows.

Both these project revisions will be presented at the first Tri-partite Review.

The first TPR is planned for 11 November 1988. This will follow the International Jute Organisation's meeting of its Project Committee at which both UNIDO'S back-stopping officer and the CTA will be present. Immediately before the TPR, the first Internal Evaluation will take place and so the evaluation team's report will be available for the examination at the TPR meeting.

Proposed new activity

Submitted by Head, Centre for Machine Design & Development

Development objective:

Through the application of established wrap-spinning technology the scope of jute yarns, fabrics and other products could be widened in India and abroad.

Immediate objectives:

1. To make primary carpet backing cloth with wrap-spun yarn as (a) weft and (b) both warp and weft.
2. To make carpet pile yarns with jute as core and wool (or other fibres) as sheath by warp-spinning.

Background justification:

1. Jute primary backing cloth.

Export markets of primary carpet backing cloth have been lost to synthetic materials. One reason for this is jute's loss in tensile strength arising from needle penetration during tufting. In wrap-spun yarns the fibres are not twisted as they are in conventional yarns but are wrapped helically with a fine filament and the fibres lie more or less parallel to the axis of the yarn. As a result, needle impact does not rupture the fibres to the same extent during tufting. Background work at IJIRA indicates that the tensile properties are not affected significantly during the tufting operation. This would perhaps allow jute to regain at least a small portion of the market which it has lost.

2. Jute/wool face yarns for carpets.

Core spun carpet face yarn with jute as the core and wool (or other high-value fibre) has the advantage of combining the surface properties of wool with a low-cost jute core. Yarns produced in this manner have better abrasion resistance, better bulk, higher extensibility and improved performance compared to all-jute yarns while at the same time being cheaper than comparable all-wool yarns.

Outputs:

1. A new type of primary backing cloth made from jute wrap-spun yarns.
2. Technical literature on the product giving manufacturing specifications for the cloth and user experience in the tufting mills.
3. Assistance to any mill who wishes to make such products.
4. A new range of blended jute yarns suited for use as carpet pile.
5. Technical literature containing specifications for the yarn and its manufacture and the properties of carpets made from it.
6. Assistance to any mill who wishes to market such yarns.

Activities:

1. Installation and operation of pilot plant
2. Performance evaluation at the mill level
3. Commercial production of larger samples
4. Evaluation of the products in India and overseas

Inputs:

a. Government.

Senior staff	1
Supervisory staff	2
Support staff	3
All equipment and pilot plants	
Sites for pilot plants	

b UNDP/UNIDO.

See overleaf.

Project Budget Covering Government Contribution
(In Rupee)

	1988		1989		1990	
	m/m Rs		m/m Rs		m/m Rs	
1	Tex. Technologist	6 27,000	6 27,000	3 14,000		
2	Asst. Technologist	12 36,000	12 36,000	6 18,000		
3	Assistants	18 27,000	18 27,000	9 14,000		
	Sub total	<u>36 90,000/-</u>	<u>36 90,000/-</u>	<u>18 46,000/-</u>		
	Travel cost	5,000/-	5,000/-	5,000/-		
	Component total	<u>98,000/-</u>	<u>95,000/-</u>	<u>51,000/-</u>		

II H Work Plan :

- 1 Two suitable prototype wrap spinning machines from two different manufacturers with at least 12-spindles each would be procured and be installed in a suitable member mill.**
Time.....6 months from Start
- 2 Samples of different products have to be made and their quality have to be evaluated.**
Time.....6 months.
- 3 Commercial production of different end products both in spinning and also post-spinning process have to be evaluated under mill condition.**
Time.....6 months.
- 4 Commercial products of different kinds have to be evaluated both in India and abroad.**
Time.....6 months.

**Equipment & Supplies to be provided
by Government of India (IJIRA)**

Expendable equipment and supplies :

Chemicals, jute, wrapping yarns, wool &
other fibres and consumable equipment etc.

Non-expendable equipments & supplies :

- 1 Two prototype weep spinning machines 6 spindles each from
two different manufacturers (already assured by Govt. of India)

D. P. Khatua
5.4.68.
(D. P. KHATUA)

APPENDIX 1

Automated sack-sewing

Assume a typical sewing section working on A and B Twills, Hy Coes and DW Flours and making 30,000 bags per shift of 8 hours. The labour for cutting and sewing would be roughly -

Cutting machine	1800 bags/hr	2 machines	9 workers
Hemming machine	300	13	23
Herakles machine	180	21	37

		Total direct workers	69
		Others	210

		Department total	279

Now assume the best conditions for an automatic line i.e. the makers waive ALL development charges and the machines work at 80% efficiency and only need 2 men per machine and it is possible to reduce the "others" by 50%

Cutter/hammer	336 bags/hour	12 machines	24 men
Side sewer	240	16	32

		Total direct workers	56
		Others	105

		Total workers	161

The number of workers saved is $279 - 161 = 118$ and 118 workers earning Rs56 per day costs US\$508 per shift

The capital cost of the new equipment is US\$ 5,064,000. Taking depreciation at 15% and interest on capital at 10%, these two items alone equal \$1407 per shift against an optimistic labour saving of \$508 per shift. The conclusion does not need stating.